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Public Attitudes

Science and Technology: Public Perceptions, Awareness, and Information Sources

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This publication is part of the *Science and Engineering Indicators* suite of reports. *Indicators* is a congressionally mandated report on the state of the U.S. science and engineering enterprise. It is policy relevant and policy neutral. *Indicators* is prepared under the guidance of the National Science Board by the National Center for Science and Engineering Statistics, a federal statistical agency within the National Science Foundation. With the 2020 edition, *Indicators* is changing from a single report to a set of disaggregated and streamlined reports published on a rolling basis. Detailed data tables will continue to be available online.

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Executive Summary

Key takeaways:

- Public confidence in science and scientists remains high, with the majority of American adults reporting positive assessments of science and scientists.
- A higher percentage of American adults had great confidence in both medical scientists (e.g., science practitioners such as physicians) and scientists generally in 2020 than they did in 2016; 24% reported a "great deal" of confidence in medical scientists in 2016, and 43% of respondents reported such confidence in 2020, with an increase from 21% to 39% for scientists generally.
- The majority of American adults report a basic understanding of scientific research principles such as the usefulness of a study control group for comparison with a treatment group. At the same time, those who demonstrate greater understanding of scientific logic tend to express more trust in scientists to act in the best interest of society than those who express less understanding.
- American adults report seeking information on science more than their counterparts in most other countries with similarly high levels of research and development spending. In 2018, the majority of American adults had recently sought information about medicine or disease.
- Only a minority of American adults report any recent experience with various science activities, such as making observations for a research project (7%) or participating in an online crowdsourcing activity related to data collection for science (3%).
- Households with greater parent educational attainment or income report more exposure to science through children's activities, such as school projects, than do households with lower educational attainment or income.

This thematic report presents indicators of public perceptions of science and technology (S&T), public familiarity with science research processes, and American adults' exposure to sources of science information as well as their involvement in scientific activities. American adults include people at least 18 years old who live in a U.S. household. Many of the data presented in this report were collected prior to the COVID-19 pandemic, although some data reflect perceptions measured during the pandemic.

Researchers have measured Americans' understanding of S&T for decades and have noted a pattern of positive perceptions about science and scientists over time. This report describes that pattern and considers how those perceptions vary between people with different characteristics. The report also describes the state of research on public understanding of specific science and engineering topics (such as climate change science) and perceptions of certain types of S&T professionals (such as engineers).

How communication professionals present scientific developments can shape public reactions; descriptions of how scientists conduct research can improve or discourage public acceptance of information resulting from that research. This report describes evidence on public reaction to clinical trials, for example, which suggests that announcing in advance that an evidence base will develop over time and that conclusions about outcomes might change over time can lessen negative public reaction to later news about changes in scientific conclusions.

The report also describes ways in which public perceptions of S&T may have shifted with recent developments such as the COVID-19 pandemic, the advent of new technologies, and media coverage of environmental news. For example, a higher percentage of American adults expressed confidence in scientists in November 2020, following the onset of the COVID-19 pandemic, than in 2016. Recent literature also describes how changes in public perceptions of S&T can occur as people's experience with S&T changes; for example, personal experience with automated technology and artificial intelligence can positively affect trust perceptions over time.

This thematic report concludes with a description of Americans' exposure to science information as well as their participation in science activities. Most American adults report not recently participating in a science activity, such as making observations for a science research project or participating in an online crowdsourcing activity to identify animals. Moreover, participation in science activities varies by demographics, with those households with greater parent educational attainment or income reporting more science activity exposure. American adults largely have not been participating in scientific research activities, and those with less income or educational attainment report relatively less participation.

Introduction

Public perceptions of science and technology (S&T) in the United States affect many aspects of civic life. They predict citizen engagement with formal science education (Vincent-Ruz and Schunn 2018), support for investment in S&T (Besley 2018; Muñoz, Moreno, and Luján 2012), and the ways in which the public talks about scientific discoveries (Southwell and Torres 2006). Public encounters with, and understanding of, science can also help predict behavior toward scientific organizations and future patterns of science, engineering, technology, and mathematics (STEM) training (VanMeter-Adams et al. 2014).

Given the potential consequences of public perceptions on the S&T enterprise in the United States, researchers have been studying public understanding of science for decades (Durant, Evans, and Thomas 1989; Hilgartner 1990; Leshner 2003; Allum et al. 2008; Funk et al. 2019). The National Science Board has published numerous iterations of the *Science and Technology: Public Attitudes, Knowledge, and Interest* report that include data on trends in opinions, attitudes, and behaviors related to S&T. (For information on the most recent previous version of this report, see NSB *Indicators 2020* report "[2020] Science and Technology: Public Attitudes, Knowledge, and Interest.")

Although measuring public perceptions of S&T has been a long-standing project for social science research, measurement itself has evolved as researchers have come to recognize the complexity of those perceptions. Earlier researchers tended to focus on deficits in science knowledge as a key criterion for evaluating public understanding of S&T, such as testing factual knowledge about antibiotics. More recently, however, researchers have turned to measuring public perceptions of science practice and scientific institutions. That understanding includes a range of ideas and beliefs that may not always align neatly with knowledge of scientific facts (Miller 2004; Allum et al. 2008). Patterns of public perception also evolve over time, suggesting that both cross-sectional and longitudinal data (meaning data captured at one point in time and data generated over time) are sometimes necessary to accurately track and evaluate public beliefs about S&T.

Some researchers view science as operating within larger social and cultural contexts—such as public discourse about values, the roles of institutions, and specific threats to health and well-being—that must be acknowledged in thinking about how people perceive scientific research (see Bauer 2009; Brossard and Lewenstein 2010; Lewenstein 1992). These changing considerations of science as an endeavor and of the roles of scientific institutions intersect with long-standing national measurement efforts that use stable indicators to track public understanding of science over time. As a result, any effort to summarize public perceptions of science must address the tension between established measurement efforts that have not changed substantially over time and evolving conversations about what measures of public understanding of S&T are possible and appropriate.

This report draws on relevant peer-reviewed research and offers indicators and data on three important dimensions of public understanding: (1) Americans' perceptions of S&T issues; (2) how well they understand scientific logic and research processes; and (3) where they encounter science and get scientific information. When possible, the discussion includes both aggregate U.S. data on public perceptions and data broken down by demographic characteristics. The report also includes some information comparing Americans' public perceptions of S&T to those of their counterparts in other countries with high levels of spending on S&T research and development (R&D).

Public Perceptions of Science and Technology

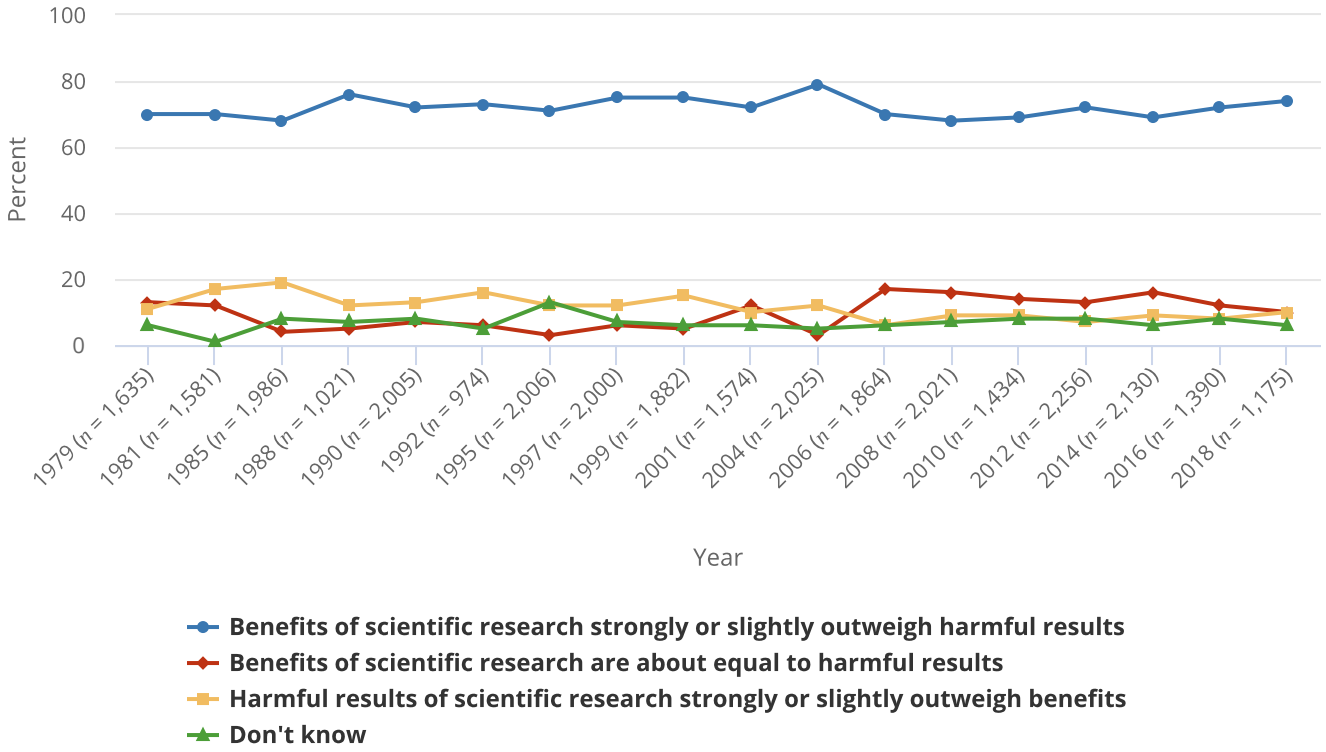
Public opinion on S&T includes beliefs about the general promise and benefits of scientific research for society as well as awareness and perceptions of specific scientific topics, including those of recent interest like research on severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and COVID-19; citizen science; and artificial intelligence (AI), robotics, and automation technology. Social science research also highlights new insights about public perception of long-standing concerns such as climate change and the state of science education in the United States.

General Perceptions of S&T

Americans' support for S&T as a general enterprise has been consistently quite positive for at least four decades. For nearly five decades, the General Social Survey (GSS)—a nationally representative survey of adults in the United States—has assessed Americans' perceptions of S&T (Smith et al. 2012–18). From 1979 to 2018, the GSS found a clear majority of American adults agreed that the benefits of scientific research strongly or slightly outweigh the harmful results (**Figure PPS-1**). From 1992 to 2018, the GSS also found that most Americans surveyed believed that there would be more opportunities "for the next generation" because of S&T (**Figure PPS-2**) and that they supported federal funding for basic scientific research, even when they did not expect that research to produce immediate benefits.

Figure PPS-1

Public assessment of benefits and harms of scientific research: Selected years, 1979–2018



n = number of survey responses.

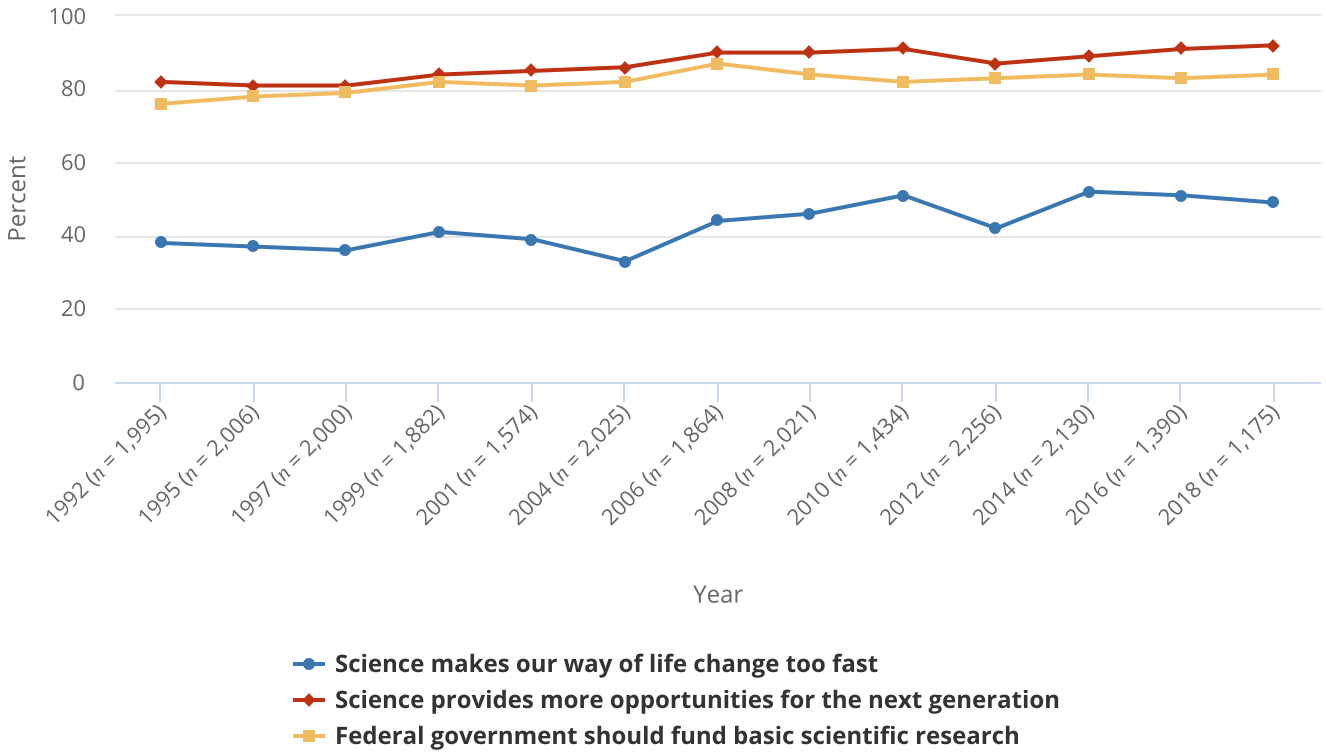
Note(s):
Percentages may not add to 100% because of rounding. See Table SPPS-1 for standard errors. Figure displays data for years when the question was proffered. Responses are to the following: *People have frequently noted that scientific research has produced benefits and harmful results. Would you say that, on balance, the benefits of scientific research have outweighed the harmful results, or have the harmful results of scientific research been greater than its benefits?* In this figure, "Benefits...outweigh harmful results" and "Harmful results...outweigh benefits" each combine responses of "strongly outweigh" and "slightly outweigh."

Source(s):
Data are sourced from multiple surveys that used either identical or similar survey items. National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1979–2001); University of Michigan, Survey of Consumer Attitudes (2004); NORC at the University of Chicago, General Social Survey (2006–18).

Science and Engineering Indicators

Figure PPS-2

U.S. adults who agree that science makes our way of life change too fast, that science provides more opportunities for the next generation, and that the federal government should fund basic scientific research: Selected years, 1992–2018



n = number of survey responses.

Note(s):
See Table SPPS-2 through Table SPPS-4 for additional detail. See Table SPPS-5 through Table SPPS-7 for standard errors. Responses are to the following: *Science makes our way of life change too fast. Because of science and technology, there will be more opportunities for the next generation. Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the federal government.* Figure displays the percentage of respondents who "strongly agree" or "agree" with the aforementioned statements.

Source(s):
Data are sourced from multiple surveys that used either identical or similar survey items. National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1992–2001); University of Michigan, Survey of Consumer Attitudes (2004); NORC at the University of Chicago, General Social Survey (2006–18).

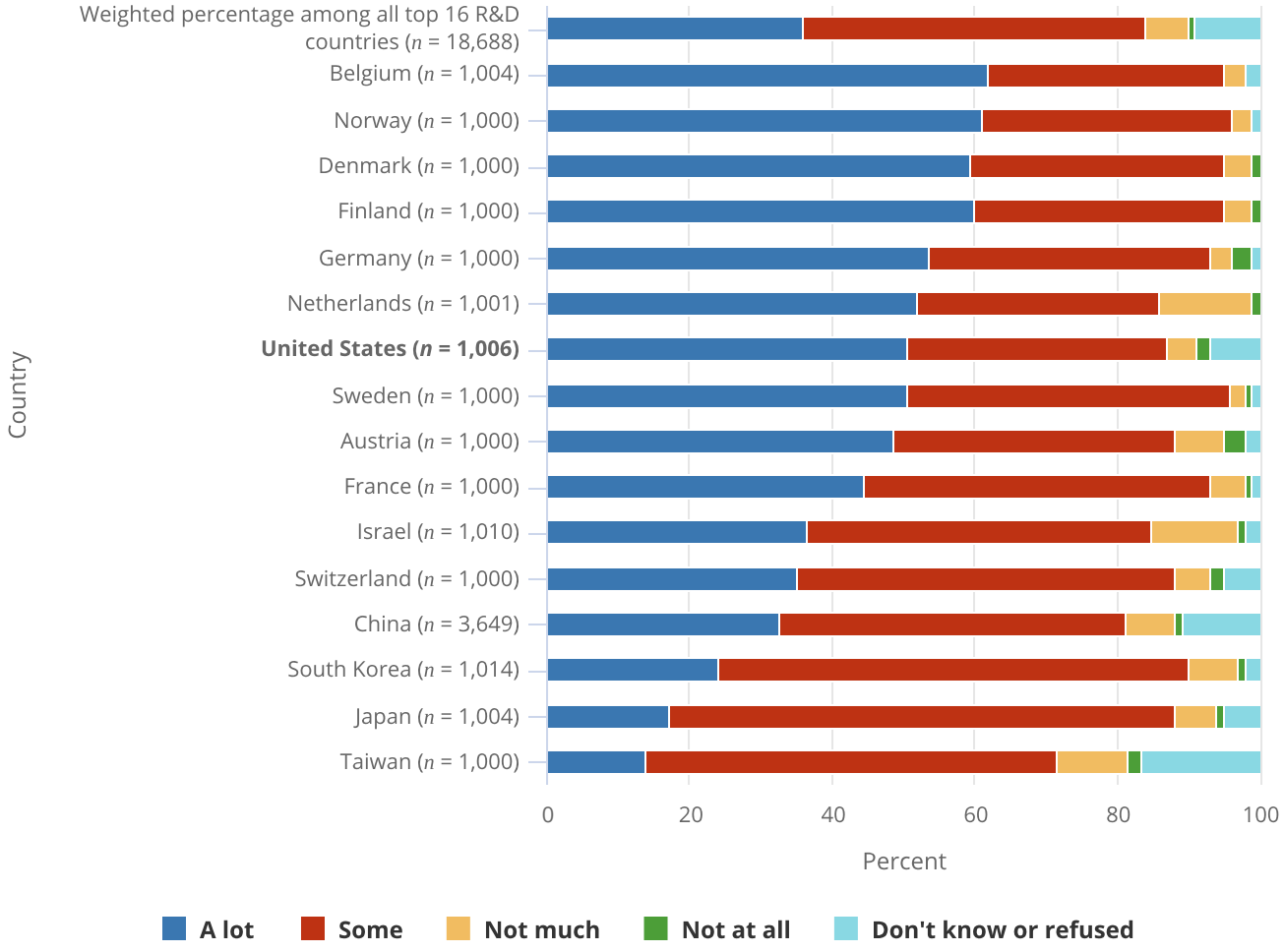
Science and Engineering Indicators

One exception to Americans' tendency to support S&T has been the perception that science makes life change too fast. In the last decade, Americans have been almost evenly split about the view that science has such a downside (**Figure PPS-2**). From 2010 to 2018, the GSS found that roughly half of respondents agreed or strongly agreed that "science makes our way of life change too fast," moving up from an average of 38% from 1995 to 1999 to an average of 50% from 2014 to 2018.

Americans also have tended to report that they trust in science, and that stance is similar to residents of the other countries that spend the most on S&T R&D compared to the rest of the world. According to the 2018 Wellcome Global Monitor survey (Gallup 2019b)—the world's largest study on how people around the world think and feel about science and major health challenges—a majority of Americans surveyed reported that they trust science "some" or "a lot." This stance was consistent with citizens in the top 16 countries with the largest gross domestic expenditure on R&D as a percentage of gross domestic product (GDP) as of 2017 (**Figure PPS-3**).

Figure PPS-3

Trust in science, by country: 2018



n = number of survey responses.

Note(s):
Percentages may not add to 100% because of rounding. See Table SPPS-8 for standard errors. Countries are those with top 16 gross domestic expenditures on R&D as a percentage of gross domestic product in 2017, listed in order of percentages that trust science "a lot" from highest to lowest. (See *Science and Engineering Indicators 2020* "[2020] Research and Development: U.S. Trends and International Comparisons" report: Table 4-5.) Responses are to the following: *In general, would you say that you trust science a lot, some, not much, or not at all?*

Source(s):
Gallup, Wellcome Global Monitor, 2019.

Science and Engineering Indicators

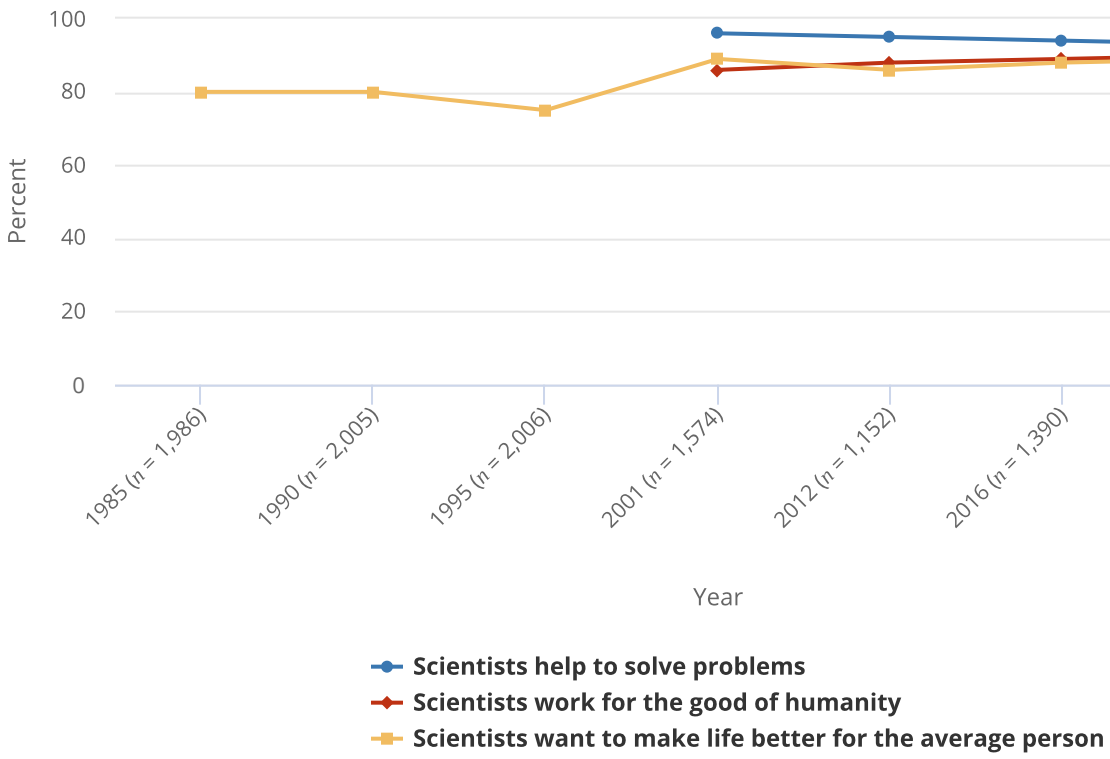
Despite Americans' general endorsement of science and the stability of their general perceptions of science over time, there are some notable differences in confidence in S&T between some groups. One source of those variations is the extent to which people understand how scientists conduct research and use the logic of science to generate evidence. This issue will be explored later in this report; see section **Public Familiarity with Science and Technology Research Processes**.

Perceptions of Scientists

In the decades spanning the late 20th and early 21st centuries, Americans' confidence in scientists has been high relative to their confidence in other professionals (Krause et al. 2019). A high level of Americans' confidence in scientists to act in the best interests of society is evident in GSS data spanning from 1985 through 2018. Over that period, several surveys, including the GSS, asked respondents the extent to which they agreed that scientists are dedicated people who work for the good of humanity, help to solve challenging problems, and work to make life better for the average person (**Figure PPS-4**). A consistently high percentage of Americans agreed with those statements in every survey, although there has been some fluctuation. For example, the percentage of Americans who believe scientists work to make life better for the average person ranged from 80% in 1985 to 89% in 2018. The 2021 GSS cross-section study fielded a similar question from December 2020 to May 2021 asking about the extent to which participants have confidence in the "scientific community," and results also suggested widespread confidence.[1] According to 2021 GSS results, half of Americans had a "great deal of confidence" in the "scientific community," and another 43% expressed "only some" confidence, whereas a minority of adults—approximately 7%—expressed "hardly any confidence at all" (Davern et al. 2021). The tendency of the majority of Americans to express confidence in scientists and scientific institutions is notable, given that some recent headlines have implied a decline in Americans' levels of trust or even their widespread mistrust in scientists without accompanying evidence (Fearnow 2021; Piccone 2020).

Figure PPS-4

Public perception of scientists: Selected years, 1985–2018



na = not applicable; question was not asked.

n = number of survey responses.

Note(s):
See Table SPPS-9 for additional years and detail. See Table SPPS-10 for standard errors. Data represent respondents who "strongly agree" and "agree" with the following: *Scientists are helping to solve challenging problems*; *Scientific researchers are dedicated people who work for the good of humanity*; and *Most scientists want to work on things that will make life better for the average person*.

Source(s):
Data are sourced from multiple surveys that used either identical or similar survey items. National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1985–2001); NORC at the University of Chicago, General Social Survey (2012–18).

Science and Engineering Indicators

Following the onset of the COVID-19 pandemic, in April and May 2020 Americans' confidence in scientists to act in the best interests of the public also appeared to have increased somewhat beyond historical trends (Funk, Kennedy, and Johnson 2020), suggesting that the value of some types of scientific research became more apparent to Americans in the first year of the pandemic compared to the time before the pandemic. In April and May 2020, the Pew Research Center conducted a survey with American adults and repeated questions it had asked in 2016 and 2019 about their confidence in medical scientists and scientists in general to act in the best interests of the public (Funk, Kennedy, and Johnson 2020). In 2016, 24% reported a "great deal" of confidence that medical scientists would act in the public interest. But in spring 2020, this percentage increased to 43% of respondents reporting that level of confidence in medical scientists. For scientists generally, 21% of respondents expressed a great deal of confidence in 2016, compared to 39% in spring 2020.

Globally, 2018 and 2020 Wellcome Global Monitor studies in 113 countries also have demonstrated an increase in the percentage of those who trust scientists "a lot." The 2018 and 2020 studies differed in the number of countries included and by interview modality; the 2020 study, conducted primarily between September and December 2020, occurred in fewer countries than the 2018 study and included telephone interviewing rather than face-to-face interviews. Nonetheless, each of the two studies included participants from a common set of 113 countries. Data from those countries point to an increased level of trust in scientists: 43% of people answered "a lot" when asked about how much they trust in "scientists in this country" in late 2020 versus 34% who answered "a lot" in 2018 (Gallup 2021).

Although confidence in scientists has remained high for decades, Americans are not uniform in their expressed confidence, suggesting some variation in trust in scientists. According to November 2020 data from Pew Research Center's American Trends Panel (ATP),[2] 84% of U.S. adults expressed "a fair amount" or "a great deal" of confidence in scientists to act in the best interests of the public (**Table PPS-1**). Confidence in scientists differed by education and income. For example, 54% of U.S. adults with a postgraduate degree expressed a great deal of confidence in scientists, whereas 30% of U.S. adults with a high school degree or less did. Half of U.S. adults in the highest of three family income tiers in the survey expressed a great deal of confidence, while 32% of U.S. adults in the lowest family income tier expressed that same level of confidence. What accounts for the differences in confidence in scientists between adults with different education and income levels is an important empirical question. The 2020 American Trends Panel data demonstrate limited differences in confidence in scientists as a function of respondent race and no differences as a function of respondent sex (**Table PPS-1**). Later, this report will assess one factor that predicts confidence—namely, the extent to which people understand how scientific inquiry ideally occurs. (See section **Public Familiarity with Science and Technology Research Processes**.)

Table PPS-1

Confidence in scientists to act in the best interests of the public, by demographic characteristics: 2020

(Percent)

Characteristic	Level of confidence in scientists			
	A great deal	A fair amount	Not too much	None at all
All adults (*n* = 6,283)	39	45	13	3
Sex				
Male (*n* = 2,799)	39	46	12	3
Female (*n* = 3,435)	38	45	14	2
Race or ethnicity				
White (*n* = 4,311)	40	44	12	3
Black (*n* = 507)	35	44	19	2
Hispanic (*n* = 999)	35	51	13	2
Asian (*n* = 180)	50	46	4	*
Family income category[a]				
Upper income (*n* = 1,848)	50	40	8	1
Middle income (*n* = 2,925)	39	47	11	2
Lower income (*n* = 1,251)	32	46	17	4
Education				
Postgraduate (*n* = 1,714)	54	38	7	1
College graduate (*n* = 1,841)	47	42	9	1
Some college (*n* = 1,833)	38	46	12	3
High school or less (*n* = 884)	30	49	17	3

* = value < 1%.

n = number of survey responses.

[a] Income tiers are based on 2019 family incomes that have been adjusted for household size and cost of living in respondents' geographic region. Middle income includes respondents whose family incomes are between two-thirds of and double the median adjusted family income among the panel of respondents. For a three-person household, upper income is approximately $116,801 and above, middle income is $38,900–$116,800, and lower income is less than $38,900.

Note(s):
Percentages may not add to 100% because the nonresponse category for level of confidence is not shown. See Table SPPS-11 for standard errors. Responses are to the following: *How much confidence, if any, do you have in [scientists] to act in the best interests of the public?*

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 79, conducted 18–29 November 2020. Data were provided to the authors by the center prior to public release.

Science and Engineering Indicators

Perceptions of Engineers and Engineering

Social science researchers have limited evidence of the extent to which Americans draw fine distinctions between the categories of scientists and engineers. Some experimental evidence comparing survey respondents' answers to questions about scientists and engineers suggests that Americans tend not to differentiate between scientists and engineers in terms of their value to society (see NSB *Indicators 2020* report "[2020] Science and Technology: Public Attitudes, Knowledge, and Interest"). Notably, for example, 2012 GSS survey respondents who were asked general questions about scientists (as to **whether a respondent would be happy if their child became a scientist** or **whether scientists work for the good of humanity**) responded similarly to those who were asked questions about engineers (regarding **being happy if their child became an engineer** and **whether engineers work for the good of humanity**).

In 2013, Pew Research Center surveyed Americans regarding their perceptions of the contributions of various occupational groups to society's well-being. That work suggested a majority of American adults hold medical doctors, scientists, and engineers in roughly equal regard (Pew Research Center 2013). Among American adults, 63% believed engineers contribute a lot to societal well-being, 65% believed scientists contribute a lot to societal well-being, and 66% believed medical doctors do so. Moreover, only a small percentage of adults believed medical doctors (8%), scientists (8%), or engineers (7%) contribute nothing or not very much to societal well-being. Those positive perceptions of engineering generally align with earlier survey research commissioned for the National Academy of Engineering (NAE 2008).

In addition, older evidence on perceptions of engineers and engineering (and on comparative perceptions of engineers and scientists) in the United States has come primarily from student populations at the elementary and middle school levels. Some evidence suggests that elementary school students tend to perceive engineers as men engaged in the activities of "building" or "making," while other evidence suggests middle school students tend to have no clear perception of engineers or their work activities (Capobianco et al. 2011; Reeping and Reid 2014; Fralick et al. 2009). These same middle school students had more substantial mental models of science, reporting that they mostly work indoors conducting experiments (Fralick et al. 2009).

Perceptions of Specific S&T Issues

Although Americans have tended to broadly support S&T, they sometimes express concerns about specific issues that arise with the publication of new research and the introduction of new technologies. As described in this section, recent peer-reviewed literature highlights evidence on public perceptions of a variety of topics, including research related to COVID-19; understanding of AI, robotics, and automation technology; perceptions of climate change and climate change research; and beliefs about STEM education. These issues have been prominent in recent public discussions or may be relevant to evaluating Americans' trust in scientific institutions, understanding of scientific processes, or exposure to scientific activities.

Artificial Intelligence, Robotics, and Automation Technology

Data from 3M's State of Science Index Survey suggest some uncertainty among Americans over the definition of *artificial intelligence* (AI).[3] When Americans were asked how much they know about AI, over a fifth reported knowing "nothing" about AI (22%), a minority (17%) reported that they know "a lot," and 62% reported knowing "some" (3M 2020). Recent evidence also suggests that public understanding of AI, robotics, and automation technology may change in coming years. Evidence suggests, for example, that popular conceptions of automation technology and robotics change as more people have opportunities for direct experience with various automated applications. Tenhundfeld and colleagues (2019, 2020) found that participants' willingness to rely on an automatic parking feature in an electric car varied as a function of how much experience they had with the technology. Over time, as they gained more experience with the feature, participants' tendency to allow automation to control the car increased (measured as the lack of behavioral intervention to stop the automated system from operating) (Tenhundfeld et al. 2020).

In a different example, Sanders and colleagues (2017, 2019) investigated human perceptions of robots in terms of perceived trust and willingness to allow a robot to perform various tasks. One of these studies (Sanders et al. 2017) found that prior interaction with robots was positively associated with trust in them. Another study (Sanders et al. 2019) found participants were more likely to choose a robot for a task that was relatively dangerous and was likely to result in death. Respondents were also more likely to choose humans to do mundane warehouse tasks, noting job and income considerations for human workers and the implications of robots replacing human workers.

Popular imagination regarding AI beyond automated mechanical tasks and robotics is potentially fertile ground for future investigation, but currently much about human perceptions of AI remains undocumented. Available evidence suggests that AI has become an increasingly relevant topic in public discussions about science. Fast and Horvitz (2017) studied 30 years of *New York Times* references to AI—between 1986 and 2016—and found that mentions of AI, including references both to optimism and concerns about ethics and loss of control, began increasing in 2009.

Recent survey research shows some ambivalence in public opinion about AI R&D. On the positive side, analysis by Zhang and Dafoe (2019) of a public opinion poll of 2,000 adults (age 18 and older) found that a substantial number (nearly half) of Americans support further development of AI, defined in the survey as "computer systems that perform tasks or make decisions that usually require human intelligence" (Zhang and Dafoe 2019:5). This study is consistent with results from a Pew Research Center report (Johnson and Tyson 2020) in which roughly half of U.S. respondents said that the development of AI "has mostly been a good thing for society."

Recent survey research on AI, however, suggests a substantial proportion of the United States is currently uncertain about AI R&D. More than a third of participants in the Zhang and Dafoe (2019) analysis neither supported nor opposed AI development (28%) or were unsure about what they thought of AI development (10%). What support currently exists for research on AI appears to be conditional. The vast majority (82%) of those surveyed by Zhang and Dafoe believed robots or AI should be carefully managed. Zhang and Dafoe also note that educational attainment is positively associated with support for AI development and that trust in organizations to develop and manage AI varied as a function of the type of organization, with relatively more support for universities compared with some other types of organizations. Taken together, current public perception research on AI suggests that many Americans lack awareness about AI or feel uncertain about it, yet they feel some conditional optimism about it as well. The vast majority appear to have some concern about future management of the technology.

COVID-19 Research

The COVID-19 pandemic is relevant to this report in several ways. First, evidence suggests that COVID-19 news coverage may have increased public consideration of, and trust in, science generally during spring 2020, as detailed in the **Perceptions of Scientists** section. (For more, see Funk, Kennedy, and Johnson 2020.) Second, Americans' understanding of COVID-19 and their perceptions of COVID-19 research itself fall squarely within the subject matter covered here. Finally, the pandemic affected many public opinion data collection efforts beginning at least as early as 2020, constraining some potential sources of information for this report and others. The accompanying sidebar highlights relevant evidence on U.S. perceptions of COVID-19 research specifically and suggests how the pandemic experience offers an example of public perceptions developing over time. (See sidebar **U.S. Public Perceptions of COVID-19 Research**.)

SIDEBAR

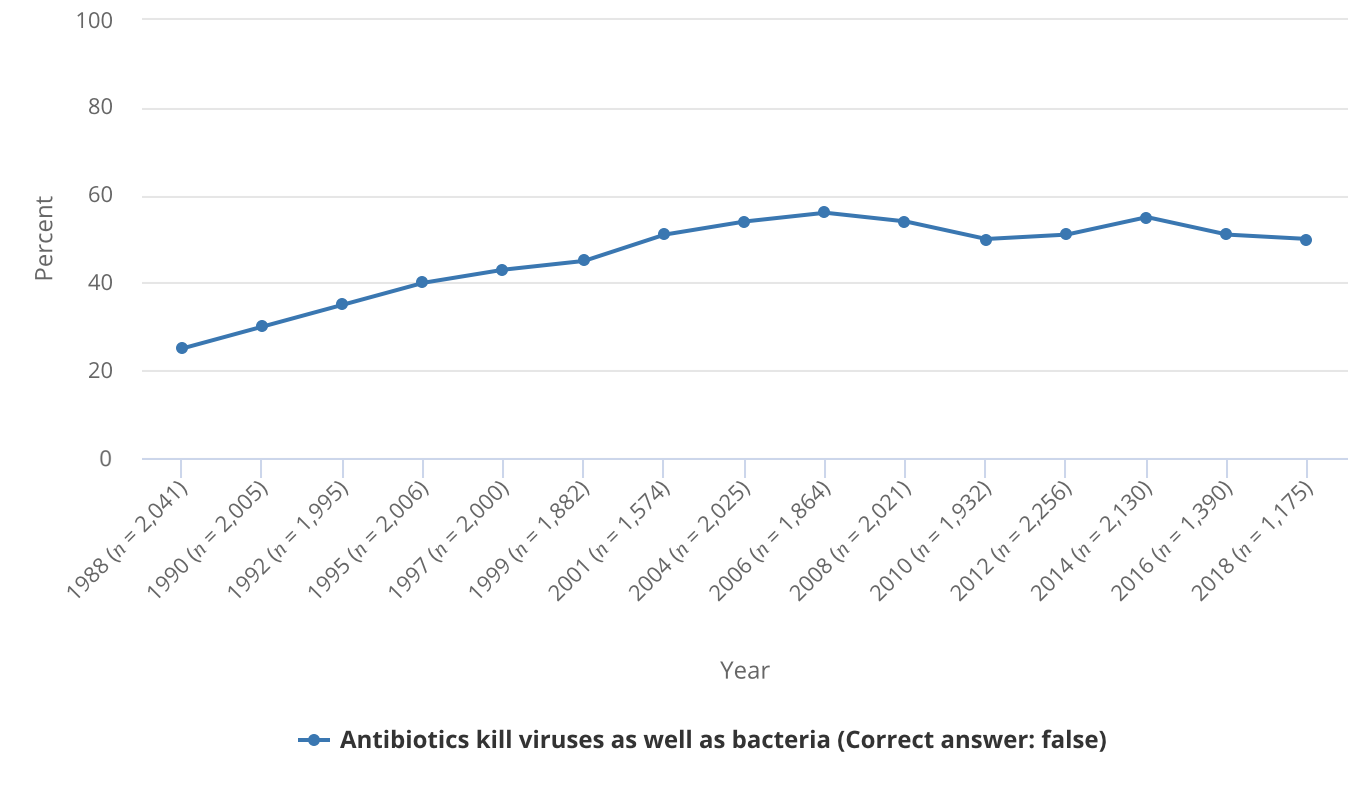
U.S. Public Perceptions of COVID-19 Research

Evidence on public perceptions of the COVID-19 pandemic and related research is useful for assessing public understanding of and support for COVID-19 science and can inform thinking about public perceptions of science and technology (S&T) more broadly, including the possibility for public perceptions to change over a relatively short period. Two striking themes related to COVID-19 that emerge from recent work are the potential for changes in public perceptions and the potential influence of information context and framing.

During earlier periods without pandemic circumstances in the United States, public understanding of viruses changed slowly over time. For example, various surveys (see **Figure PPS-A**) have assessed the extent to which Americans believe that antibiotics similarly kill both viruses and bacteria—an inaccurate claim that has been discredited by peer-reviewed studies (Kenealy and Arroll 2013). Although the percentage of Americans who believe this claim has dropped over time, half of Americans held this belief in 2018.

Figure PPS-A

Respondents who correctly answered factual knowledge question about whether antibiotics kill viruses: Selected years, 1988–2018



n = number of survey responses.

Note(s):
See Table SPPS-12 for standard errors. Figure displays data for years when the question was proffered.

Source(s):
Data are sourced from multiple surveys that used either identical or similar survey items. National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1988–2001); University of Michigan, Survey of Consumer Attitudes (2004); NORC at the University of Chicago, General Social Survey (2006–18).

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National research on U.S. perceptions of COVID-19 transmission, prevention, and treatment conducted early in the pandemic revealed widespread public uncertainty. For example, McCormack et al. (2021) surveyed Americans regarding COVID-19 from late February through early March 2020 and found considerable uncertainty and confusion:

- In February and March 2020, more than 30% of respondents did not know whether antibiotics can be used to prevent COVID-19 infection, and another 7% incorrectly believed antibiotics could be used for that purpose.
- In February and March 2020, more than 25% did not know whether a vaccine to prevent COVID-19 infection was available at the time of the survey.
- The majority of respondents in February and March 2020 did not know that most people infected with COVID-19 have only mild symptoms.

Evidence also suggests public perceptions of COVID-19 did not form in a vacuum devoid of existing perceptions, conflicting information, or public considerations of information sources. Some evidence suggests that in the early months of the pandemic, American perceptions of coronaviruses reflected past experiences with other viruses such as influenza viruses (Southwell et al. 2020). Americans also have reported challenges with a complicated COVID-19 information environment, including the existence of directly conflicting information about COVID-19 in their usual encounters with mass media and their social network interactions. In the first year of the pandemic, Nagler and colleagues (2020) found that the majority of respondents in a national survey of U.S. adults self-reported having seen or heard conflicting reports about COVID-19.

The way in which media outlets and research spokespeople present COVID-19 research has affected public confidence in research outcomes as well. For example, Kreps and Kriner (2020) found that the way COVID-19 research is framed predicted whether study participants would use that research for decision-making. Explicit references to uncertainty in COVID-19 study results had a detrimental short-term impact on the perceived credibility of research for participants, but descriptions of COVID-19 research that delineated the uncertainty of infection forecast models appeared to bolster, or at least maintain, longer-term public support when initial research results were supplanted by new evidence. Such results are consistent with earlier recommendations by scholars, such as Druckman (2015), for proactive disclosure of uncertainty in presenting results.

Perceived confidence in R&D for COVID-19 vaccines also has been a focal point for investigation. The Pew Research Center reported that in November 2020, 75% of U.S. adults expressed at least a fair amount of confidence that research would produce a safe and effective vaccine, a percentage that appears to have increased relative to earlier polling by the center (Funk and Tyson 2020). At least some evidence suggests increased American confidence during the first year of the pandemic in scientific research processes related to vaccines.

Public acceptance of COVID-19 vaccination in 2021 appeared to reflect considerable confidence in science. In January 2021 and September 2021, the U.S. Census Bureau collected responses to its Household Pulse Survey (HPS) on COVID-19 vaccination intention; **Table PPS-A** and **Figure PPS-B** highlight these data (Census Bureau 2021a, 2021b).* In January 2021, the majority of respondents reported that they definitely or probably would get a COVID-19 vaccine when available. Those who said they would not or definitely would not get a COVID-19 vaccine (which constituted 22% of all respondents) had a variety of justifications. For example, 21% did not believe the vaccine was personally necessary, and 7% said their doctor had not yet recommended it. Around a third reported a lack of trust in COVID-19 vaccines (34%) or lack of trust in government (28%) as considerations in their decision not to get vaccinated. By September 2021, many American adults who had intended to get vaccinated in January had received a COVID-19 vaccine; the pool of respondents who had not been vaccinated decreased dramatically in September relative to January. Among those not intending to get vaccinated, concerns about side effects were a prominent reason cited in both January and September. In addition, a greater percentage of those not intending to get vaccinated cited trust in COVID-19 vaccines as a concern in September relative to January, although fewer unvaccinated people (in absolute number) remained in September relative to January and fewer respondents overall expressed lack of intention to get vaccinated against COVID-19 in September relative to January.

Table PPS-A

COVID-19 vaccination status and intent to get a COVID-19 vaccine, Household Pulse Survey: January 2021 and September 2021

(Percent)

Characteristic	January 2021	September 2021
Received a COVID-19 vaccine[a] (January, *n* = 80,567; September, *n* = 63,536)		
Yes	13	82
Intent to get a COVID-19 vaccine among those who have not[b] (January, *n* = 65,539; September, *n* = 7,001)		
Definitely yes	54	8
Probably yes	23	10
Unsure	na	20
Probably no	12	18
Definitely no	10	38

na = not applicable; response option not on the survey.

n = number of survey responses.

[a] "Yes" indicates survey respondents who reported receiving at least one dose.

[b] Percentages may not add to 100% because nonresponse category is not shown. "Unsure" response option was unavailable in January data collection.

Note(s):
See Table SPPS-13 for standard errors. Survey population includes those aged 18 years or older. The self-reported vaccination data in this table differ from Centers for Disease Control and Prevention (CDC) data. According to CDC, the percentage of U.S. adults aged 18 years or older who had received at least one dose of a COVID-19 vaccine was 76% as of 12 September 2021 (https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-Jurisdi/unsk-b7fc/data). Responses are to the following:
- *Have you received a COVID-19 vaccine?* (January data collection)

- *Have you received at least one dose of a COVID-19 vaccine?* (September data collection)

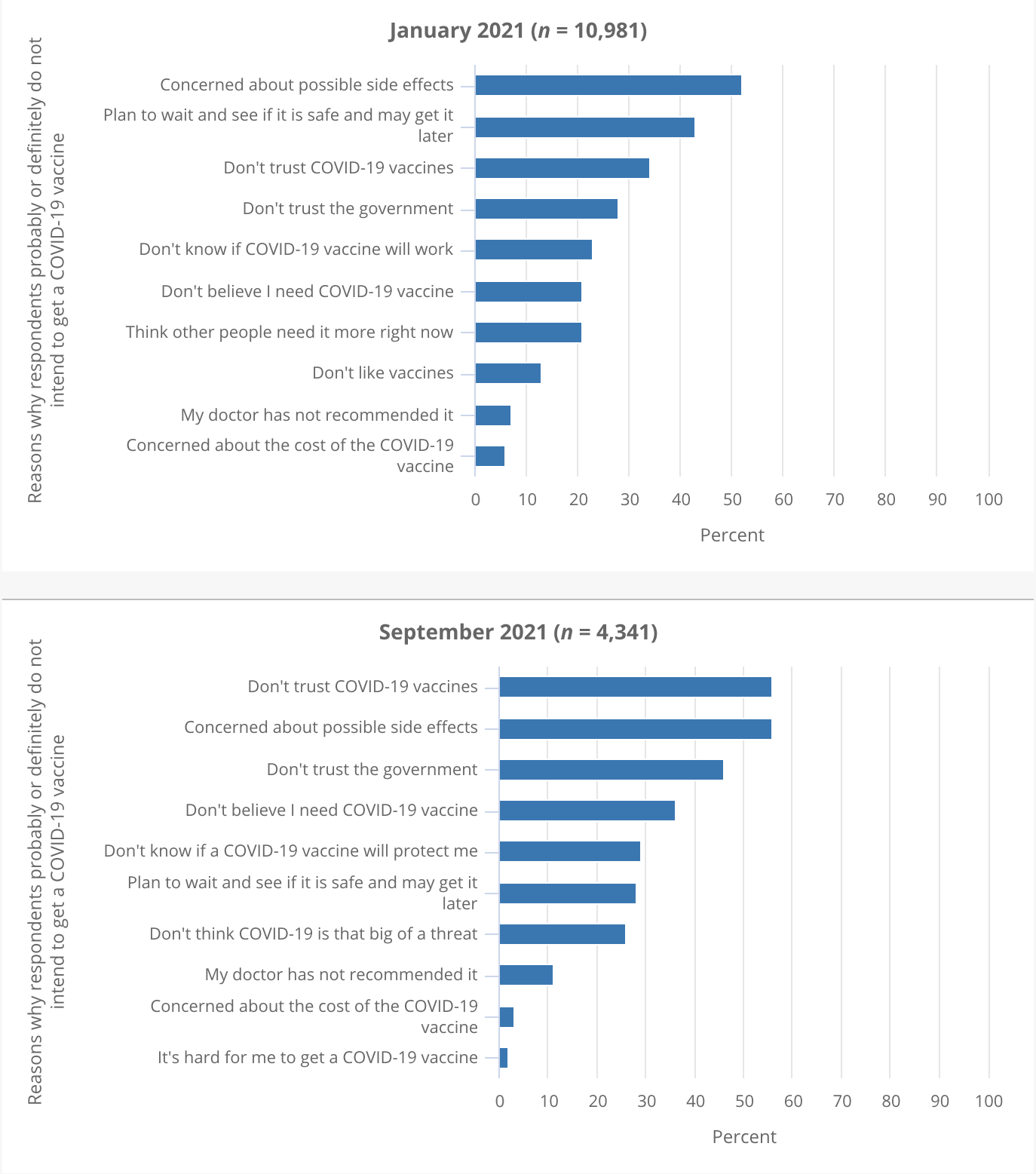
- *Once a vaccine to prevent COVID-19 is available to you, would you…*
Definitely get a vaccine.
Probably get a vaccine.
Be unsure about getting a vaccine (response option unavailable in January data collection).
Probably NOT get a vaccine.
Definitely NOT get a vaccine.

Source(s):
U.S. Census Bureau, Household Pulse Survey, Phase 3, Week 23 (20 January–1 February 2021), and Phase 3.2, Week 37 (1–12 September 2021).

Science and Engineering Indicators

Figure PPS-B

Among those who have not received a COVID-19 vaccine, reasons for intending not to get a vaccine: January 2021 and September 2021



n = number of survey responses.

Note(s):
See Table SPPS-14 for standard errors. Survey population includes those 18 years old or older who reported not having received a COVID-19 vaccine and who responded that they probably or definitely did not intend to get a vaccine. Reasons offered differed slightly in the January and September questionnaires. Respondents could select multiple reasons. Reasons do not sum to 100%. January and September surveys reflect two different cross-sectional samples. Responses are to the following: *Which of the following, if any, are reasons that you [probably won't/ definitely won't] [get a COVID-19 vaccine]? (Select all that apply).*

Source(s):
U.S. Census Bureau, Household Pulse Survey, Phase 3, Week 23 (20 January–1 February 2021), and Phase 3.2, Week 37 (1–12 September 2021).

Science and Engineering Indicators

Social science research on interventions to affect COVID-19 perceptions demonstrates that beliefs and behaviors related to COVID-19 are amenable to change through communication efforts. Breza et al. (2021), for example, reported that messages recorded by health professionals and posted to social media sites discouraged November and December 2020 holiday travel in the United States and reduced COVID-19 infections. Insights on communication intervention possibilities (see Brunson et al. 2021) also have been reported by the Societal Experts Action Network, an initiative formed by the National Academies of Sciences, Engineering, and Medicine with support from the National Science Foundation and the Alfred P. Sloan Foundation.

Taken together, evidence of public perceptions of COVID-19 research suggest some positive changes in perceptions of pandemic-related science over time as the pandemic has unfolded. Trust in science, complexity of the information environment, and lack of transparency in research descriptions appear to have affected Americans' perceptions of infectious disease during this time. Evidence in 2021 nonetheless suggested that the majority of Americans had confidence in research related to COVID-19 prevention and mitigation.

* The U.S. Census Bureau conducted the HPS, in collaboration with multiple federal statistical agencies, to quickly and efficiently assess "how the coronavirus pandemic is impacting households across the country from a social and economic perspective." The HPS was conducted in three phases. Data presented here is from Phases 3 and 3.2, which were conducted in 2-week periods, with data released the week following the end of the period. As part of the Census Bureau's Experimental Data Series, data products from the HPS may not meet some of the agency's statistical quality standards; provided confidence intervals do not account for nonsampling errors that may occur due to the speed at which the survey was conducted. The survey provides an indicator of how Americans' circumstances and opinions have evolved during the pandemic. For more information, see **https://www.census.gov/programs-surveys/household-pulse-survey/technical-documentation.html**.

Climate Change Perceptions

There has been an increase in recent decades in the percentage of Americans who have expressed concern about the rise in the Earth's average temperature over time (see *Indicators 2020* report ***Science and Technology: Public Attitudes, Knowledge, and Interest***). In 1994, 35% of Americans who participated in the GSS believed that a "rise in the world's temperature caused by the greenhouse effect" is "extremely" or "very" dangerous. By 2018, the GSS reported that 58% of Americans surveyed believed this. This pattern of increased concern is consistent with other recent studies (Leiserowitz et al. 2019; Gallup 2019a). Although concern has increased generally, younger Americans appear to be relatively more concerned than their older counterparts. In the 2018 GSS sample, concern varied as a function of education and age; younger respondents and those with relatively more education were more concerned than their counterparts who were older and had relatively fewer years of education (see *Indicators 2020* report ***Science and Technology: Public Attitudes, Knowledge, and Interest***).

The extent to which Americans are concerned about climate change, however, is not necessarily related to their perceptions of climate change research. Research on Americans' beliefs about climate change science suggests both relatively broad support for including climate scientists in government policy deliberation as well as a common perception that climate scientists do not yet understand climate change well. A majority of U.S. adult respondents in a 2016 Pew Research Center study agreed that climate scientists should have a major role in making decisions about policy issues related to global climate change (Pew Research Center 2016). At the same time, 33% agreed that climate scientists understand the occurrence of climate change "very well." An even smaller percentage (28%) agreed that climate scientists understand "very well" the causes of climate change, and only 19% agreed that "climate scientists understand very well the best ways to address climate change." An April 2021 Pew Research Center survey found similar results on perceptions of scientists' understanding of climate change causes and remedies (Funk 2021). These results suggest that Americans generally acknowledge the relevance of climate science research to societal decision-making and that they also focus on what they believe is not yet empirically known to climate researchers.

Recent research on public understanding of climate change offers insight on factors that can shape and influence perceptions. Exposure to news stories can directly affect public opinion about climate change—both in terms of the general importance of the issue as well as issue-framing effects (Newman, Nisbet, and Nisbet 2018). News references to the credibility of science and scientific institutions can indirectly affect beliefs about the credibility of climate change research (Hmielowski et al. 2014). The extent to which a person has thought about climate change previously also appears to limit possibilities for media content to affect beliefs about climate change (Wonneberger, Meijers, and Schuck 2020). Research indicates that perceptions of climate change and climate change research are functions of both existing beliefs and patterns in the information environment—suggesting *potential* for change but also relative stability as consistent news coverage and online information accumulate over time.

STEM Education

Public perception of STEM education in K–12 U.S. public schools comprises a mix of fond recollection for STEM classes, concern about present investment in K–12 schools, and widespread judgment that STEM education offered to elementary, middle, and high school students in the United States is worse than that offered in at least some other countries. A Pew Research Center survey (Funk and Parker 2018) found that 75% of adult respondents reported that they liked science courses during their time as K–12 students. When asked to choose whether they liked those courses because of the subject matter itself or because of the way the subject matter was taught, 68% of those who liked their science courses said the subject matter was the main reason they enjoyed those classes. Despite their fondness for their own STEM experiences, only a quarter of respondents considered K–12 STEM education in the United States to be at least above average "compared with other developed nations" (Funk and Parker 2018:86). They held similar perceptions of both undergraduate and graduate STEM education in the United States, as fewer than half of respondents thought either undergraduate or graduate STEM education in the United States outranked what is available in other countries. Future inquiry could explore the basis for such perceptions.

Respondents in the 2018 Pew Research Center report (Funk and Parker 2018) saw opportunities for improvement in U.S. STEM education. Approximately 3 in 10 respondents believed that K–12 public schools should emphasize at least one STEM subject more than was currently the case in schools at the time of the survey. (For the Pew Research Center survey, STEM subjects included mathematics and statistics, science and engineering [S&E], and computers and computer science.) In terms of future opportunities for improvement, a majority of respondents cited lack of parental involvement in public STEM education as a concern, and approximately half believed that teaching methods should further emphasize critical thinking and applying STEM subject matter to everyday life. Together, these beliefs suggest that most Americans see value in STEM education but also believe that STEM instruction in U.S. public schools could be improved.

Public Familiarity with Science and Technology Research Processes

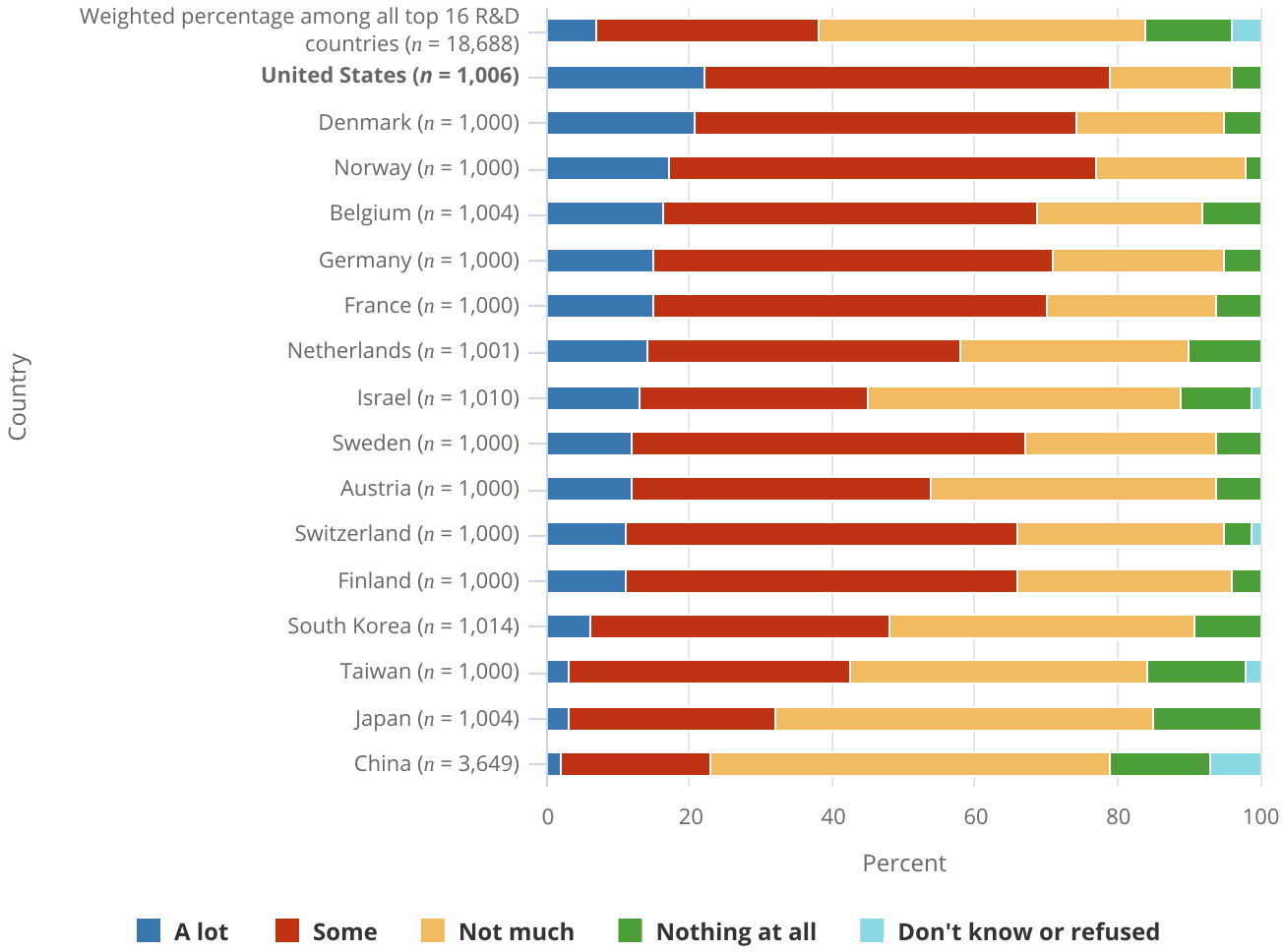
As noted earlier, research on public perceptions of science has shifted over time. Although earlier work focused on public knowledge of facts, more recent work emphasizes how people understand the practice of science. Recent research on public understanding of science has begun to assess what people know about *how* scientists perform scientific research (Hendriks, Kienhues, and Bromme 2020). Scientists can vary in their methods of inquiry and the quality of that inquiry. At least some recent research has assessed the extent to which people tend to understand basic principles of scientific inquiry that are often taught in the context of higher education science training.

What Americans understand about the ways in which rigorous S&T research is conducted is also relevant to how the general U.S. population views S&T institutions and professionals. Knowing how well Americans understand the processes that S&T professionals use to make observations about the world can offer insights about the context of, and even potential explanations for, their general perceptions about S&T. For example, proactively acknowledging that uncertainty is an element of the scientific process because scientists continue to test ideas over time can encourage confidence in science in general (Druckman 2015; Jamieson and Hardy 2014).

Many Americans admit to not having much scientific knowledge when asked for their subjective report of how much they know. Data from the 2018 Wellcome Global Monitor survey found that 22% of Americans surveyed believed they knew “a lot” about science (**Figure PPS-5**). This was, nonetheless, a higher percentage than was reported by citizens of all other 15 countries with the largest gross domestic expenditure on R&D as a percentage of GDP except Denmark, which was not statistically different in the percentage reported. On average, 7% of citizens across all 16 surveyed countries said they knew “a lot” about science.

Figure PPS-5

Perceived knowledge about science, by country: 2018



n = number of survey responses.

Note(s):
Percentages may not add to 100% because of rounding. See Table SPPS-15 for standard errors. Countries are those with top 16 gross domestic expenditures on R&D as a percentage of gross domestic product in 2017, listed in order of percentages that perceive knowing "a lot" about science from highest to lowest. (See *Science and Engineering Indicators 2020* "[2020] Research and Development: U.S. Trends and International Comparisons" report: Table 4-5.) Responses are to the following: *How much do you, personally, know about science? Do you know a lot, some, not much, or nothing at all?*

Source(s):
Gallup, Wellcome Global Monitor, 2019.

Science and Engineering Indicators

Recent evidence suggests a majority of Americans understand the nature of science as an iterative process of observation and testing, although a substantial number of U.S. adults do not view science in that manner. According to American Trends Panel data collected in November 2020 by Pew Research Center,[4] when asked which of a series of statements best describes the practice of science, a majority (66%) believed that the scientific method produces findings that are meant to be continually tested and updated over time, but a substantial minority of respondents (34%) believed that the process produces “unchanging core principles and truths” or was unsure (**Table PPS-2**). These results suggest that most American adults understand the possibility of changes over time in the empirical evidence generated by

scientific research, but a third does not. At least some scientific knowledge reflects a relatively established body of evidence and does not change often, which some respondents might understand; nonetheless, the majority of respondents in the Pew Research Center study also acknowledged that science can include new studies to test established ideas.

Table PPS-2

Americans' understanding of the scientific method: 2020

(Percent)

Indicator of scientific method understanding	Total
Understanding that science is iterative (*n* = 12,648)	
Believe the scientific method produces findings meant to be continually tested and updated over time	66
Believe the scientific method identifies unchanging core principles and truths[a]	34
Understanding that science yields accurate results[b] (*n* = 12,648)	
Believe the scientific method generally produces accurate conclusions	67
Believe the scientific method can be used to produce any conclusion the researcher wants	31
Understanding of the use of control groups in a hypothetical scientific study about the effectiveness of a medication (*n* = 12,648)	
Create a control group that does not receive the medication	60
Other responses[a]	40
Understanding what a hypothesis is (*n* = 12,648)	
Selected "hypothesis" as answer	50
Selected answer other than "hypothesis"	50

n = number of survey responses.

[a] Includes "not sure" responses and refusals.

[b] Refusals are not shown.

Note(s):
See Table SPPS-16 for standard errors. Responses are to the following:
- Based on what you have heard or read, which of the following statements best describes the scientific method?
The scientific method produces findings meant to be continually tested and updated over time.
The scientific method identifies unchanging core principles and truths.
Not sure

- Which of the following best describes what you think about the scientific method?
The scientific method generally produces accurate conclusions.
The scientific method can be used to produce any conclusion the research wants.

- A scientist is conducting a study to determine how well a new medication treats ear infections. The scientist tells the participants to put 10 drops in their infected ear each day. After 2 weeks, all participants' ear infections had healed. Which of the following changes to the design of this study would most improve the ability to test if the new medication effectively treats ear infections?
Create a second group of participants with ear infections who do not use any ear drops.
Create a second group of participants with ear infections who use 15 drops a day.
Have participants use ear drops for only 1 week.
Have participants put ear drops in both their infected ear and healthy ear.
Not sure

- The time a computer takes to start has increased dramatically. One possible explanation for this is that the computer is running out of memory. This explanation is a scientific…
Hypothesis
Conclusion
Experiment
Observation
Not sure

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 79, conducted 18–29 November 2020. Data were provided to the authors by the center prior to public release.

Science and Engineering Indicators

The November 2020 American Trends Panel question regarding the iterative nature of science as an endeavor, while useful, does not directly assess how well people understand the specific contribution of any one scientific study to an overall body of evidence. It is possible that some people understand that scientific evidence can be updated and should be assessed multiple times and yet still do not understand, for example, that a crucial test of a hypothesis can add more useful evidence than many other types of empirical observations.

Additional evidence from the American Trends Panel reveals that a majority of adult Americans have some substantive understanding of experimental logic and could correctly note that a control group can be useful in making sense of study results (**Table PPS-2**). When asked, however, only half of U.S. adults surveyed could correctly identify a scientific hypothesis. Those results indicate that a sizable proportion of the U.S. adult population does not currently understand the scientific process of hypothesis testing in the same way that professional scientists working in scientific communities do.

Americans' understanding of scientific logic and of the effectiveness of the scientific method is positively related to their confidence in scientists to act in the public's best interests, which is an indicator of trust. Trust comprises not only perceptions of competence but also perceptions of shared interest between parties (Southwell et al. 2019). Data collected by Pew Research Center in November 2020 support a link between individuals' understanding of science as a process and their confidence in scientists. Accurate understanding of the scientific process was positively associated with respondents' expression of "a great deal" of confidence in scientists to act in the public's best interests. For example, 44% of those who accurately reported that the scientific method produces findings meant to be continually tested and updated also expressed a great deal of confidence in scientists to act in the best interests of the public. By comparison, a lower percentage (29%) of those who held that "the scientific method identifies unchanging core principles and truths" expressed such confidence. In addition, half of respondents who agreed that the scientific method generally produces accurate conclusions expressed a great deal of confidence in scientists, whereas 15% of those who agreed that the "scientific method can be used to produce any conclusion the researcher wants" expressed a great deal of confidence in scientists "to act in the best interests of the public" (**Table PPS-3**).

Table PPS-3

Confidence in scientists to act in the best interests of the public, by perception of the scientific method: 2020

(Percent)

Perception of the scientific method		Level of confidence in scientists			
		A great deal	A fair amount	Not too much	None at all
All respondents (*n* = 6,283)		39	45	13	3
Perception that science is iterative	Believe the scientific method produces findings meant to be continually tested and updated over time (*n* = 4,669)	44	43	11	1
	Believe the scientific method identifies unchanging core principles and truths[a] (*n* = 1,614)	29	49	17	5
Perception that science yields accurate results	Believe the scientific method generally produces accurate conclusions (*n* = 4,658)	50	41	7	1
	Believe the scientific method can be used to produce any conclusion the researcher wants (*n* = 1,511)	15	53	25	6

n = number of survey responses.

[a] Includes "not sure" responses and refusals.

Note(s):
Percentages may not add to 100% because the nonresponse category for level of confidence is not shown. See Table SPPS-17 for standard errors.
Responses are to the following:
- How much confidence, if any, do you have in [scientists] to act in the best interests of the public?

- Based on what you have heard or read, which of the following statements best describes the scientific method?
The scientific method produces findings meant to be continually tested and updated over time.
The scientific method identifies unchanging core principles and truths.
Not sure

- Which of the following best describes what you think about the scientific method?
The scientific method generally produces accurate conclusions.
The scientific method can be used to produce any conclusion the research wants.

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 79, conducted 18–29 November 2020. Data were provided to the authors by the center prior to public release.

Science and Engineering Indicators

In addition to asking about confidence in scientists generally "to act in the best interests of the public," the November 2020 Pew Research Center survey asked a similar question regarding medical scientists. The pattern of responses regarding confidence in medical scientists was similar to confidence in science; those who had a greater understanding of science as a process tended to have higher levels of confidence in scientists generally and in medical scientists (**Table PPS-3** and **Table PPS-4**). Among those who agreed that the scientific method generally produces accurate conclusions, 52% also expressed a great deal of confidence in medical scientists; among those not agreeing that the scientific method generally produces accurate conclusions, 17% expressed a great deal of confidence in medical scientists.

Table PPS-4

Confidence in medical scientists to act in the best interests of the public, by perception of the scientific method: 2020

(Percent)

Perception of the scientific method		Level of confidence in medical scientists			
		A great deal	A fair amount	Not too much	None at all
All respondents (*n* = 6,365)		40	45	12	2
Perception that science is iterative	Believe the scientific method produces findings meant to be continually tested and updated over time (*n* = 4,708)	46	43	10	1
	Believe the scientific method identifies unchanging core principles and truths[a] (*n* = 1,657)	29	49	17	5
Perception that science yields accurate results	Believe the scientific method generally produces accurate conclusions (*n* = 4,637)	52	41	6	1
	Believe the scientific method can be used to produce any conclusion the researcher wants (*n* = 1,598)	17	53	24	5

n = number of survey responses.

[a] Includes "not sure" responses and refusals.

Note(s):
Percentages may not add to 100% because the nonresponse category for level of confidence is not shown. See Table SPPS-18 for standard errors.
Responses are to the following:
- How much confidence, if any, do you have in [medical scientists] to act in the best interests of the public?

- Based on what you have heard or read, which of the following statements best describes the scientific method?
The scientific method produces findings meant to be continually tested and updated over time.
The scientific method identifies unchanging core principles and truths.
Not sure

- Which of the following best describes what you think about the scientific method?
The scientific method generally produces accurate conclusions.
The scientific method can be used to produce any conclusion the research wants.

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 79, conducted 18–29 November 2020. Data were provided to the authors by the center prior to public release.

Science and Engineering Indicators

Information Sources and Involvement

Where and to what extent have Americans encountered information about science? Aside from encounters with news stories about S&T, are they involved in any informal activities (i.e., activities outside of a formal school setting) that could affect their understanding or perceptions of science? Recent data offer insights on both questions. (Related thematic reports explore Americans' formal STEM training through educational institutions; see *Indicators 2022* report "[2022] Elementary and Secondary STEM Education" and *Indicators 2022* report "[2022] Higher Education in Science and Engineering.")

Sources of Information about Science

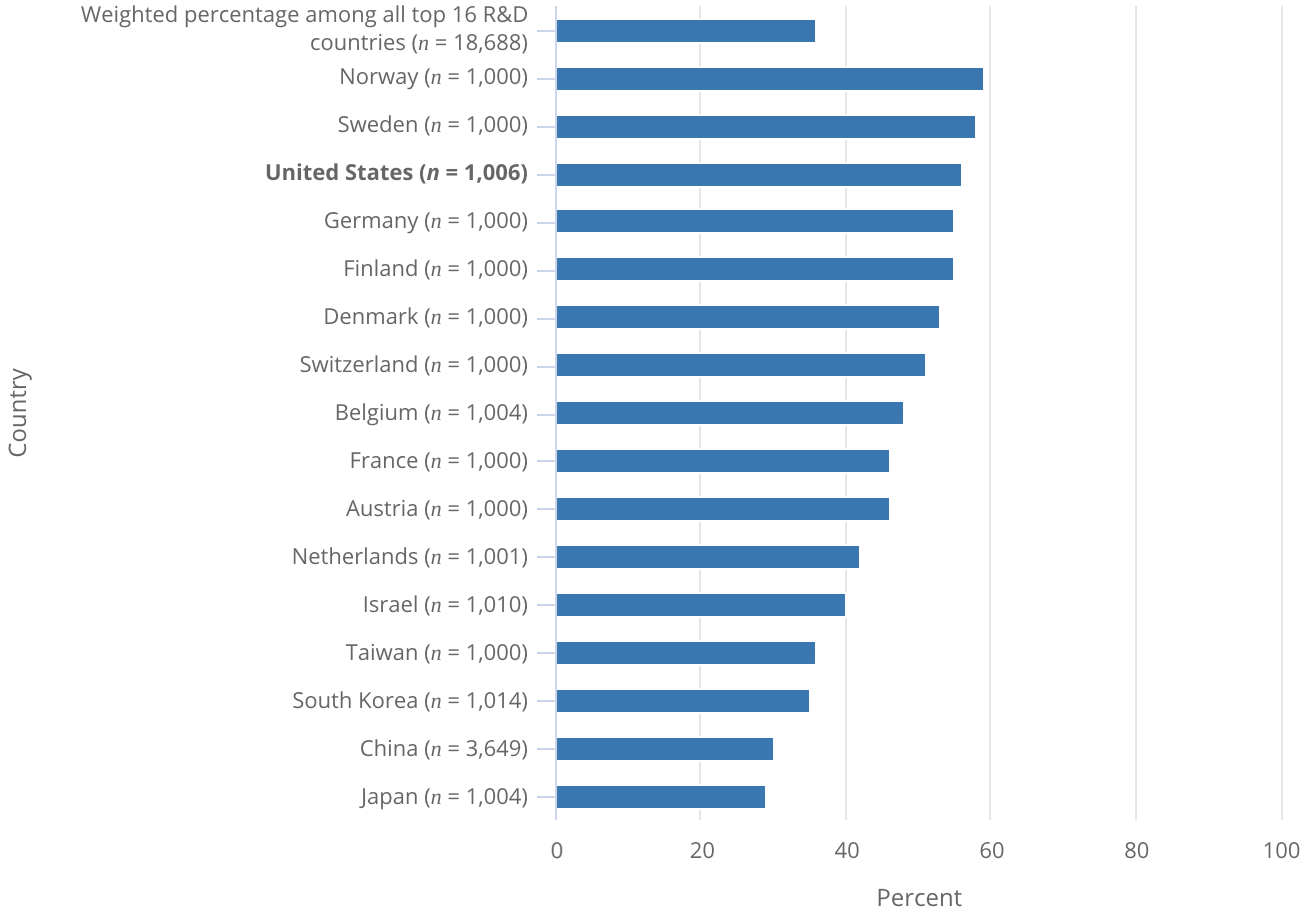
American adults tend to learn about science from general news sources rather than from specialized information sources dedicated to science. Funk, Gottfried, and Mitchell (2017) investigated where Americans were encountering information about science (and allowed respondents to note multiple sources). They found that 54% of Americans who were surveyed had reported regularly getting science information from general news outlets. Another 25% reported getting their information from print or online science magazines, and 12% said they got information from S&T centers or museums. This breakdown is notable because the content typically covered by general news outlets differs substantively from content offered by specialized science information venues. Specific details about study limitations that appear in an original, peer-reviewed article may not be reported in news coverage or highlighted in social media posts. Few local news outlets have staff who specialize in covering science, and even large news outlets often rely on press releases about new developments as sources for science news rather than offering continuing, thematic discussion of how scientific research occurs over time or covering research topics without highly publicized research results (Schafer 2017). Moreover, in the contemporary American information environment, items reported in general news outlets compete for audience attention with numerous other stories not directly related to science (Lupia 2013).

Especially in the past decade, Americans also have cited social media platforms as a source of information. In a 2020 report, for example, the Pew Research Center estimated that 18% of adults get most of their news about politics from social media using survey data collected in October and November 2019 (Mitchell et al. 2020). Social media platforms offer users a mix of user comments and shared links to online news sources external to the platform. Whether Americans who rely on social media as a primary information source for topics such as politics are regularly engaging with science journalism or science-related content online is currently unclear. Those social media users who primarily get political news from social media have tended not to closely follow recent national and international science news on the COVID-19 pandemic; only 23% of those who most commonly get information on politics from social media in a June 2020 Pew Research Center study reported following COVID-19 news "very closely" (Mitchell et al. 2020).

Data indicate that most Americans do look for S&T-related information—at least occasionally—on their own. The **2018 Wellcome Global Monitor survey** highlighted the extent to which people around the world had attempted to get information about science in the 30 days before the survey. The majority of Americans surveyed (56%) reported having sought such information (**Figure PPS-6**)—a significantly higher percentage than most of their counterparts in 15 other countries that, like the United States, make substantial investments in S&T R&D. For example, only 29% of Japanese adults who responded to the Wellcome Global Monitor survey had attempted to get information about science in the previous 30 days. Americans also had sought information about medicine and disease at higher rates than citizens of any other nation in the survey, with 72% having looked for information on medicine, disease, or health in the previous month; the average for citizens seeking similar content in all nations was 50% (**Figure PPS-7**).

Figure PPS-6

Tried to get information about science in the past 30 days, by country: 2018



n = number of survey responses.

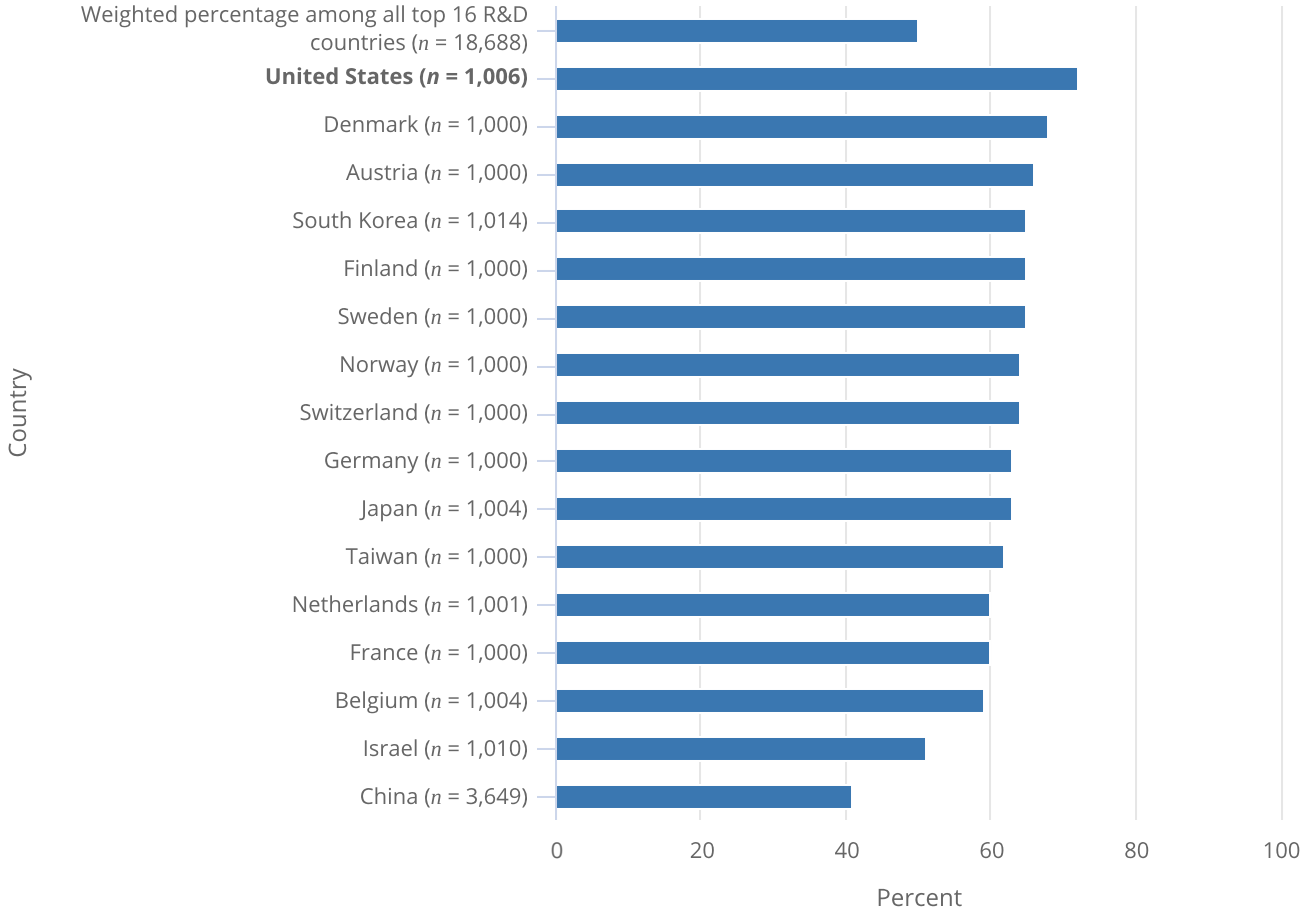
Note(s):
See Table SPPS-19 for additional detail. See Table SPPS-20 for standard errors. Countries are those with top 16 gross domestic expenditures on R&D as a percentage of gross domestic product in 2017, listed in order of percentages that tried to get information about science from highest to lowest. (See *Science and Engineering Indicators 2020* "[2020] Research and Development: U.S. Trends and International Comparisons" report: Table 4-5.) Responses are to the following: *Have you, personally, tried to get any information about science in the past 30 days?*

Source(s):
Gallup, Wellcome Global Monitor, 2019.

Science and Engineering Indicators

Figure PPS-7

Tried to get information about medicine, disease, or health in the past 30 days, by country: 2018



n = number of survey responses.

Note(s):
See Table SPPS-19 for additional detail. See Table SPPS-20 for standard errors. Countries are those with top 16 gross domestic expenditures on R&D as a percentage of gross domestic product in 2017, listed in order of percentages that tried to get information about medicine from highest to lowest. (See *Science and Engineering Indicators 2020* "[2020] Research and Development: U.S. Trends and International Comparisons" report: Table 4-5.) Responses are to the following: *Have you, personally, tried to get any information about medicine, disease, or health in the past 30 days?*

Source(s):
Gallup, Wellcome Global Monitor, 2019.

Science and Engineering Indicators

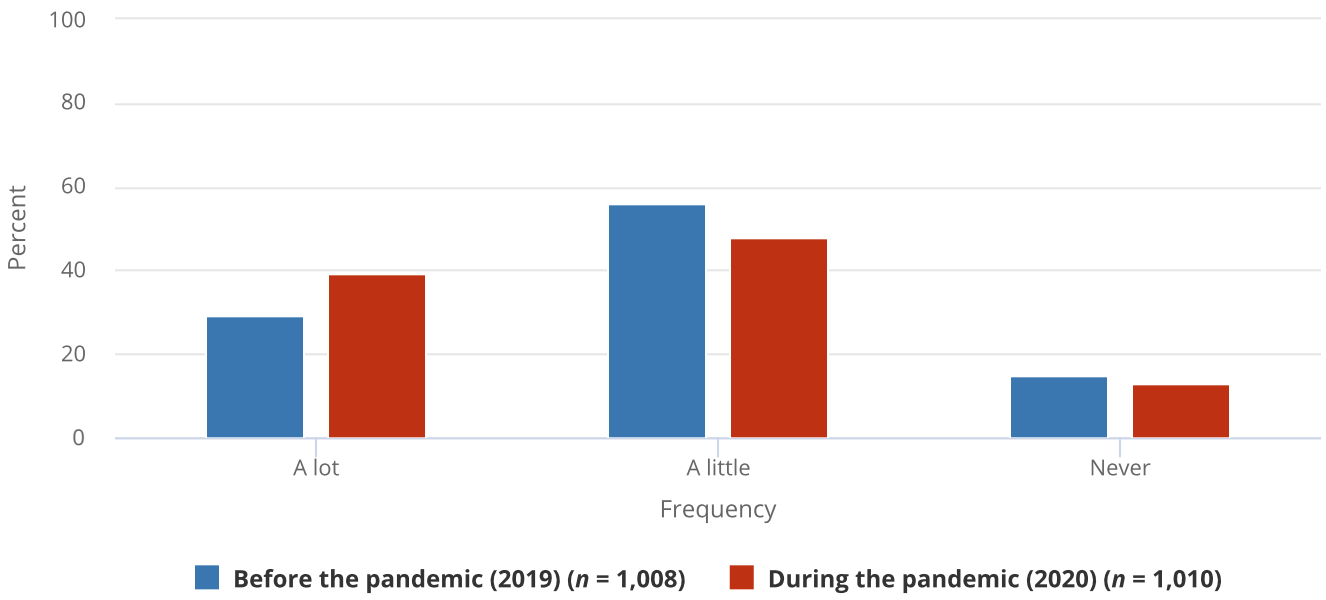
Despite survey results showing a majority of Americans seeking general scientific information on occasion, a minority of Americans have self-reported high levels of interest in various scientific topics. The 2020 *Indicators* report (NSB *Indicators 2020*: **Science and Technology: Public Attitudes, Knowledge, and Interest**) noted that 41% of 2018 GSS respondents said that they were “very interested” in new scientific discoveries. Disjuncture between the everyday concerns of many Americans and framing of science news content could help explain that pattern of Americans’ interest; one recent content analysis of science news stories in the U.S. found most stories reported a specific finding but did not discuss the process of scientific inquiry to address societal concerns, including topics such as past hypothesis test failures, disagreements by scientists, or the implications of specific findings for future work (Ophir and Jamieson 2021). Authors of the 2009

National Research Council (NRC) report on science learning in informal environments noted that the tremendous potential of informal science activities to allow citizens to reflect on science as a "way of knowing" will be fully realized only when such content places science in context and reflects the "everyday language, ideas, concerns, worldviews, and histories" of various potential audiences (NRC 2009:4–7).

Factors such as media attention on COVID-19-related scientific research and personal experiences during the pandemic may have recently elevated the relevance of science in the everyday life experiences of Americans—at least temporarily. For their 2020 State of Science Index Survey, 3M collected data from around the world[5]—both just before the nationwide spread of COVID-19 (August–October 2019) and during the pandemic (July and August 2020) (3M 2020). In late 2019, 29% of respondents who were asked about how much they "think about the impact of science in your everyday life" responded that they thought about that topic "a lot"; in 2020, however, that figure jumped to 39% (**Figure PPS-8**).

Figure PPS-8

How often U.S. adults thought about the impact of science on their everyday lives, before and during the COVID-19 pandemic: 2019 and 2020



n = number of survey responses.

Note(s):
See Table SPPS-21 for standard errors. Responses are to the following:
- How much do you think about the impact of science in your everyday life? Select one.
A lot
A little
Never

Source(s):
3M, 2020 Pre-Pandemic Survey (2019), conducted August–October 2019, and 3M, 2020 Pandemic Pulse Survey (2020), conducted July–August 2020.

Science and Engineering Indicators

Engagement with Science Activities

The extent to which American adults participate in science activities indicates one dimension of their direct opportunity to learn about scientific logic and processes. Available survey data depict low participation rates among American adults, yet recent academic literature describes various active science engagements, sometimes labeled *citizen science* or *community science* efforts.

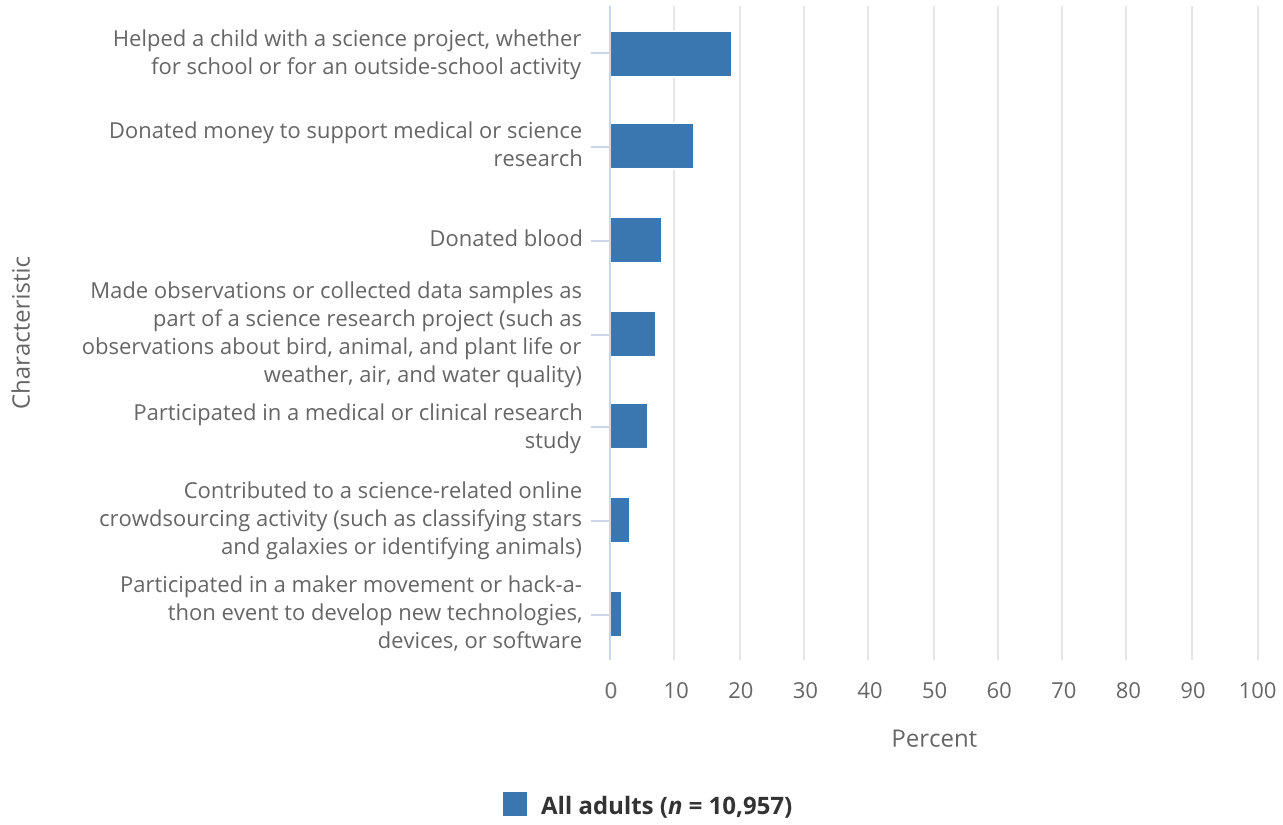
The U.S. governmental website **CitizenScience.gov** has described citizen science as public participation in the scientific process in ways that might include forming research questions, conducting experiments, collecting or analyzing data, or interpreting results (FedCCS 2019). Bonney (2021) notes that some projects have begun to use the phrase community science instead of citizen science in recent years in an effort to encourage inclusivity in participation. An example of this approach is the annual bird count organized by the Audubon Society in which volunteers report counts of various birds (Soykan et al. 2016).

At least some American adults have had opportunities to generate S&E knowledge through citizen science initiatives (Brossard, Lewenstein, and Bonney 2005; Pandya and Dibner 2018). Population-level evidence of the reach of citizen science activities nonetheless has been limited to date. For more information about the state of citizen science and the role of federal agencies as sponsors of citizen science, see the *Indicators 2022* report “[2022] Invention, Knowledge Transfer, and Innovation” "Sidebar: Citizen Science in Federal Agencies and Departments."

November 2020 data from the Pew Research Center’s American Trends Panel highlight the recent lack of direct experience with science activities among American adults. The American Trends Panel survey included questions about whether respondents had participated in a medical or clinical research study, made observations or collected data for a science research project, contributed to online crowdsourcing for a science project, or helped a child with a science project, among other activities. In November 2020, only a small percentage of U.S. adults had participated in each of those science activities in the past 12 months (**Figure PPS-9**; **Table PPS-5**). For example, 3% of U.S. adults reported contributing to online crowdsourcing for activities such as identifying animals, and 7% made observations or collected data samples for a science research project. Approximately 19% had helped a child with a science project either for school or outside of school, suggesting that exposure to science activities through children in the household offers involvement in science for some U.S. adults.

Figure PPS-9

Participation in science activities in the past 12 months: 2020



n = number of survey responses.

Note(s):
See Table SPPS-22 for standard errors. Responses are to the following:
- Thinking about things you have done outside of work over the past 12 months, have you ever done the following?
Participated in a medical or clinical research study.
Made observations or collected data samples as part of a science research project (such as observations about bird, animal, and plant life or weather, air, and water quality).
Contributed to a science-related online crowdsourcing activity (such as classifying stars and galaxies or identifying animals).
Helped a child with a science project, whether for school or for an outside-school activity.
Participated in a maker movement or hack-a-thon event to develop new technologies, devices, or software.
Donated blood.
Donated money to support medical or science research.

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 67, conducted 29 April–5 May 2020.

Science and Engineering Indicators

Although a minority of Americans recently participated in science activities, this participation varies as a function of income and education. According to 2020 Pew Research Center data, the level of household engagement with a child for a science project differed based on income or formal education (**Table PPS-5**; **Figure PPS-10**). A higher percentage of Americans with a postgraduate degree reported participating in such a project compared to those with a high school degree or less. Similarly, a higher percentage of Americans in the upper income category in the study (who earn more than

$112,600 a year) reported participating in such a project than did Americans in the lower income category (who earn less than $37,500). In other words, adults in households with relatively low incomes or with less formal education report less exposure to science activities via school projects with household children. Such differences might reflect inequity in time availability or scientific literacy (Kalil and Ryan 2020).

Table PPS-5

Participation in science activities in the past 12 months, by family income and education: 2020

(Percent)

Characteristic	Participated in a medical or clinical research study	Made observations or collected data samples as part of a science research project (such as observations about bird, animal, and plant life or weather, air, and water quality)	Contributed to a science-related online crowdsourcing activity (such as classifying stars and galaxies or identifying animals)	Helped a child with a science project, whether for school or for an outside-school activity	Participated in a maker movement or hack-a-thon event to develop new technologies, devices, or software	Donated blood	Donated money to support medical or science research
All adults (*n* = 10,957)	6	7	3	19	2	8	13
Family income category[a]							
Upper income (*n* = 4,781)	7	9	3	23	2	10	19
Middle income (*n* = 3,624)	5	6	2	19	1	8	13
Lower income (*n* = 2,085)	6	7	4	17	2	6	8
Education							
Postgraduate (*n* = 2,770)	9	12	4	27	2	9	23
College graduate (*n* = 3,176)	6	8	3	22	2	11	17
Some college (*n* = 3,294)	7	6	3	18	1	8	13
High school or less (*n* = 1,692)	4	5	3	17	1	6	8

n = number of survey responses.

[a] Income tiers are based on 2018 family incomes that have been adjusted for household size and cost of living in respondents' geographic region. Middle income includes respondents whose family incomes are between two-thirds of and double the median adjusted family income among the panel of respondents. For a three-person household, upper income is approximately $112,601 and above, middle income is $37,500–$112,600, and lower income is less than $37,500.

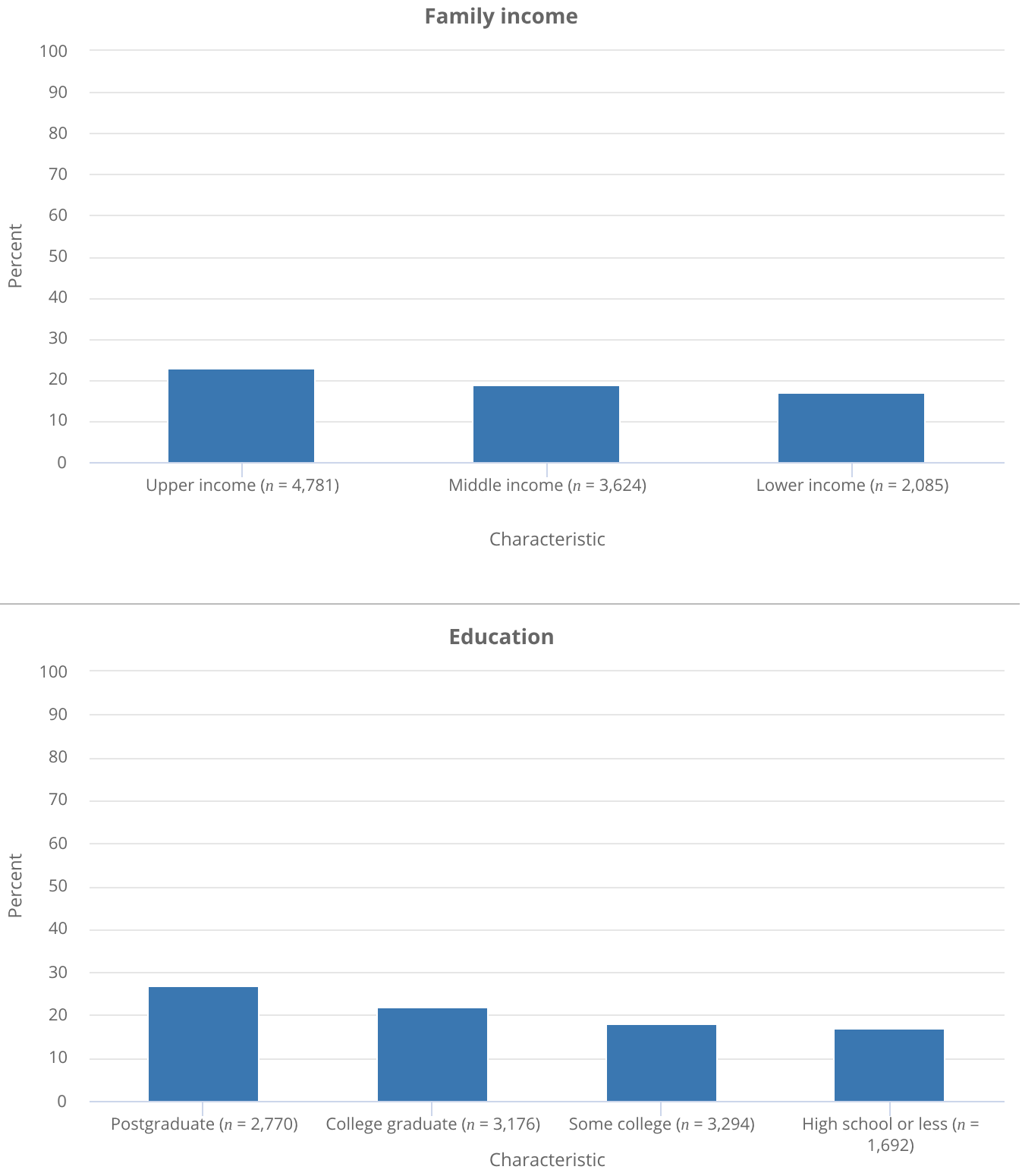
Note(s):
See Table SPPS-22 for standard errors. Responses are to the following:
- *Thinking about things you have done outside of work over the past 12 months, have you ever done the following?*
Participated in a medical or clinical research study.
Made observations or collected data samples as part of a science research project (such as observations about bird, animal, and plant life or weather, air, and water quality).
Contributed to a science-related online crowdsourcing activity (such as classifying stars and galaxies or identifying animals).
Helped a child with a science project, whether for school or for an outside-school activity.
Participated in a maker movement or hack-a-thon event to develop new technologies, devices, or software.
Donated blood.
Donated money to support medical or science research.

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 67, conducted 29 April–5 May 2020.

Science and Engineering Indicators

Figure PPS-10

Helped a child with a science project in the past 12 months, by family income and education: 2020



n = number of survey responses.

Note(s):
See Table SPPS-22 for standard errors. Income tiers are based on 2018 family incomes that have been adjusted for household size and cost of living in respondents' geographic region. Middle income includes respondents whose family incomes are between two-thirds of and double the median adjusted family income among the panel of respondents. For a three-person household, upper income is approximately $112,601 and above, middle income is $37,500–$112,600, and lower income is less than $37,500. Responses are to the following:
- *Thinking about things you have done outside of work over the past 12 months, have you ever done the following?*
Helped a child with a science project, whether for school or for an outside-school activity.

Source(s):
Pew Research Center, American Trends Panel (2020), Wave 67, conducted 29 April–5 May 2020.

Science and Engineering Indicators

Outside the classroom, there are many opportunities for informal science education in the United States. (The most recent previous version of this report discusses topics such as visits to museums and zoos; for information, see *Indicators 2020* report **Science and Technology: Public Attitudes, Knowledge, and Interest**.) For example, an exhaustive NRC report (2009) found thousands of organizations producing science content in the United States. Whether the availability of that informal content has had a robust effect on Americans' perceptions of science over time, however, is an important empirical question, as is the question of whether Americans experience equity in informal science education access.

Conclusion

Americans' perceptions of science have remained generally positive and stable over time in recent decades, although recent evidence also suggests that those perceptions are not universally held and that at least some perceptions are associated with an understanding of how scientific inquiry occurs. Confidence in science and scientists to act in the best interests of the public has remained generally high among Americans for decades because the majority of Americans have reported positive assessments of science and scientists in recent decades, and Americans generally trust science and scientists. Current confidence in science varies among Americans; understanding of science as a process is associated with trust in science, for example.

Americans report seeking information on science more than those in most other countries with high levels of R&D spending. Nonetheless, a minority of Americans report recent, direct experience with science activities such as making observations for a research project or participating in a crowdsourcing activity to identify animals. Moreover, participation in science activities varies by demographics.

Perceptions of science can change over time. Recent literature highlights potential for changes in public perceptions of new science topics, such as clinical trial research and AI. The onset of the COVID-19 pandemic, for example, appears to have made the contributions of science and scientists more evident to Americans. News coverage of scientific research that benefits society appears to sometimes bolster positive perceptions of science. At the same time, most Americans acknowledge not knowing a lot about science and generally do not report regular and direct experience with scientific activities. That pattern suggests that direct exposure to the processes of scientific inquiry that generate peer-reviewed research publications has been limited among Americans.

Glossary

Definitions

Artificial intelligence: The ability of machines to learn and draw on prior experiences to accomplish new tasks, sometimes similar to what human beings can do (Manning 2020).

Citizen science: Public participation in the scientific process in ways that can include forming research questions, conducting experiments, collecting or analyzing data, interpreting results, making new discoveries, developing technologies and applications, or solving complex problems (FedCCS 2019).

Climate change: Any distinct change in measures of climate lasting for a long period. Climate change means major changes in temperature, rainfall, snowfall, or wind patterns lasting for decades or longer. Climate change may result from natural factors or human activities. Global warming is often the focus of climate change discussion (Royal Society/NAS 2020).

COVID-19: Disease associated with severe acute respiratory syndrome coronavirus 2, labeled by the World Health Organization in February 2020 (WHO 2020).

Global warming: An average increase in the Earth's temperature. Increases in temperatures in the Earth's atmosphere can contribute to changes in global climate patterns. Global warming can be considered part of climate change along with changes in precipitation, sea level, and so on. (See *Indicators 2020* report ***Science and Technology: Public Attitudes, Knowledge, and Interest***.)

Greenhouse effect: Atmospheric gases, such as carbon dioxide, trap heat in the Earth's atmosphere. Increases in the concentration of these gases contribute to global warming. (See *Indicators 2020* report ***Science and Technology: Public Attitudes, Knowledge, and Interest***.)

Key to Acronyms and Abbreviations

AI: artificial intelligence

COVID: coronavirus disease

GSS: General Social Survey

R&D: research and development

S&E: science and engineering

S&T: science and technology

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

STEM: science, technology, engineering, and mathematics

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Notes

1 Estimates from the 2021 GSS Cross-section Study are not directly comparable to previous GSS estimates of related concepts due to differences in data collection methodology implemented during the COVID-19 pandemic as well as differences in question phrasing.

2 The Pew Research Center provided restricted-use data from November 2020 for this analysis that are presented here and in other sections of this report with the center's permission. The Pew Research Center's ATP is a nationally representative survey panel composed of more than 10,000 randomly selected adults in the United States. Respondents are frequently surveyed about a variety of topics over time, allowing researchers to build a more detailed understanding of public opinion than is possible with a single survey. New panelists are added each year to replace panelists who have dropped out or been retired from the panel. One concern with the ATP is that panelists may become conditioned to the questions, spurring them to change their behavior in response to a survey or become more skilled at answering the questions. Still, many ATP surveys interview only a subset of the panelists, which prevents survey fatigue and helps ensure that the surveys are nationally representative with less weighting. For more information about the ATP, see **https://www.pewresearch.org/our-methods/u-s-surveys/the-american-trends-panel/**.

3 3M shared data for this analysis that are presented here and used with 3M's permission. The 3M State of Science Index Survey is an independent, nationally representative research study commissioned by 3M to track global attitudes toward science. It has been conducted annually since 2018, but due to the coronavirus pandemic, two waves of data were released in 2020 after an additional survey was fielded during summer 2020. The 2020 Pre-Pandemic Survey was conducted in 14 countries, while the 2020 Pandemic Pulse Survey was conducted in 11 countries; the United States was included in both surveys. For more information about the survey methodology, see **https://www.3m.com/3M/en_US/state-of-science-index-survey/2020-summary/**.

4 As noted earlier, the Pew Research Center provided restricted-use data from November 2020 for this analysis that are presented here and used with the center's permission.

5 As noted earlier, 3M shared data for this analysis that are presented here and used with their permission.

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